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NOTES ON GEOGRAPHIC DISTRIBUTION

First record of *Pleradenophora* Esser (Euphorbiaceae) for the flora of Panama

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Abstract. *Pleradenophora membranifolia* (Müll. Arg.) Esser & A.L. Melo (Euphorbiaceae) was previously only known from central South America (Bolivia, Brazil, and Peru). Our new botanical collections from the seasonal dry forests in Garachiné, Darién Province, Panama increase the distribution of this species to Central America and include the first record of this genus for the country. We also provide photographs of field and herbarium specimens, an occurrence map, a description, and comments on the morphology and taxonomy of *P. membranifolia*.

Key words. Central America, disjunct distribution, Hippomaneae, SDTF biome, South America

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INTRODUCTION

Seasonal dry tropical forest (SDTF) in the Neotropics is a fragmented biome from northeastern Mexico to northern Argentina, including the Caribbean (Pennington et al. 2009). It is characterized by a closed canopy, fertile soils, precipitation below ~1800 mm per year, and a period of 3–6 months that has less than 100 mm of rainfall per month (DRYFLOR 2016), during which the vegetation is mostly without leaves (Sánchez-Azofeifa et al. 2005). Additionally, SDTF is one of the most threatened tropical ecosystems in the world (Miles et al. 2006).

In Panama, SDTF is mainly in an area denominated the "Dry Arc" ("Arco Seco") on the Pacific coast, which includes the provinces of Coclé, Herrera, Los Santos, Panamá Oeste, and Veraguas. However, there are also fragments of SDTF in the provinces of Colón, Darién, and Panamá. The national system of protected areas of Panama (SINAP) poorly protects the seasonally the seasonally dry forest (MiAmbiente 2017), although this ecosystem occupies around 7% (5,630 km^2) of the country (MiAmbiente 2019).

The province of Darién, in eastern Panama, is the least botanically explored region in the country (Ortiz et al. 2019). It is in the Choco biogeographic region, one of the world's most biodiverse areas, harboring nearly 3% (~11,000 species) of all plant species (Pérez-Escobar et al. 2019). In the Darién province, specifically in Punta Garachiné, we found one of the last SDTF fragments that is considerable in size and still in a good preservation in Panama (MiAmbiente 2017).

The family Euphorbiaceae comprises around 6,000 species, is an important component of drylands (Webster 2014; Carrión et al. 2023) and has interesting disjunct distribution patterns in SDTFs (Wurdack 2023). In Panama, we have found approximately 150 species of this family (PMA Herbarium unpublished data). In this work, we report the first record of *Pleradenophora membranifolia* (Müll. Arg.) Esser & A.L. Melo for Panama and Central America and the first record of *Pleradenophora* for Panama. We made this discovery due to recent floristic inventories conducted in seasonal dry forest in Garachiné, in the province of Darién, on the Pacific coast on the eastern end of Panama.

METHODS

We made the new collections of *Pleradenophora membranifolia* in Tropical Dry Forest in Garachiné (Tosi 1971), which is located on the Gulf of San Miguel, in the district of Chepigana and province of Darién. It has an average monthly precipitation of 108.7 mm, an average temperature of 27.2 °C, and an average relative humidity of 87.1%. The rainy season is from May to November and the dry season is from December to April (IMHPA 2024).

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We sampled this plant in Panama for the first time in 2013; these specimens have only pistillate flowers and immature fruits. Hans-Joachim Esser, a specialist of the tribe Hippomaneae, determined the samples to be *Pleradenophora*. Subsequently, in 2023, we returned to the same collection locality to obtain samples with bisexual inflorescences. Based on literature (Esser 2012; Melo et al. 2013) and a comparison with herbarium specimens and virtual herbarium images of *Pleradenophora*, it was possible to determine that the species is *P. membranifolia*.

We analyzed the morphology using a stereomicroscope and based the species morphological description on specimens collected in Panama, following Beentje's (2016) terminology. We utilized records with geographic coordinates available on speciesLink (2024) and determined by a specialist of the group. We prepared the distribution map with the software ArcGIS Pro v. 2.5.0. We deposited the specimens of the new records in the herbarium at the University of Panama (**PMA**).

RESULTS

***Pleradenophora membranifolia* (Müll. Arg.) Esser & A.L. Melo**, Phytotaxa 81(1): 35, 2013. *Sebastiania membranifolia* Müll. Arg., Flora Brasiliensis 11(2): 579, 1874.
Figure 1

New records. PANAMÁ – Darién • Chepigana, Garachiné, Punta Garachiné; 07°84′10.3″N, 089°49′25″W; 200 m a.s.l.; seasonal dry tropical forest; 22.VI.2013; J.F. Carrión leg.; 1160, PMA136556 • Same locality; 03.VIII.2023; J.F. Carrión leg.; 2126, PMA139849–PMA139850 (2 sheets).

Description. Tree, up to 15 m high, deciduous; trunk to 15 cm dbh, sometimes branching at a low height, bark pale beige, lenticellate, inner bark green, with whitish exudate; branches lenticellate, glabrous, cylindrical; cataphylls usually 2 with each bud, stiff. Stipules lanceolate, early deciduous, 1.5–1.8 × 0.5–0.9 cm, margin sometime reddish. Leaves alternate, spiral; petiole sometimes reddish, 6–19 mm long, caniculate on the adaxial side, with very small, scattered, glandular protuberances; lamina membranaceous, discolor, usually ovate, sometimes lanceolate (Lindley), rarely obovate, (1.5) 5.4–13.2 (15.7) × (0.5) 2.1–6.2 (8.5) cm; base subcordate to subauriculate; apex attenuate to acuminate; margin crenate to serrate; surfaces with black spots; abaxial surface sometimes with sparse, appressed, hyaline trichomes, mainly on the midvein; macular glands present on the abaxial surface, these rarely on the adaxial surface, a conspicuous pair of basilaminar glands (sometimes more than 2) usually present, these reddish brown, one on each side of the midvein, on the lamina base auricle, other smaller glands present on the margin, these more concentrated from the middle to the apex; venation pinnate; secondary veins in 7–17 pairs, tertiary veins reticulate, impressed abaxially. Inflorescence usually pistillate, rarely bisexual, terminal; when pistillate, usually solitary, sometimes 2; when bisexual, an unbranched thyrse, with a pistillate flower at the base and numerous staminate cymules towards the apex. Staminate cymules 5-flowered, spirally arranged; each cymule subtended by one basal stipitate gland and one ovate bract, 0.6–1.1 × 0.7–1.2 mm, margin incised. Staminate flowers short pedicellate, 0.2–0.4 mm long; each flower pedicel associated with one very small stipitate gland and two bracteoles, ca. 0.1–0.2 × 0.1–0.2 mm, margin incised; sepals 3, 2.1–3.0 × 0.6–1.5 mm, ovate, margin incised; stamens 2, filaments 0.1 mm long, anthers 0.2 × 0.2 mm, latrorse, dorsifixed, 2-thecate, longitudinally dehiscent, connective absent. Pistillate flowers long-pedicellate, the pedicel up to 11 mm long, slightly clavate; sepals 3, unequal in size, ovate, 1.1–1.5 × 0.8–1.5 mm, margin incised; ovary ovoid to subglobose, glabrous; styles 3, undivided, slender, 1.5–3 mm long, recurved, stigmatic surface verrucose, glabrous. Mature fruits not seen. Immature fruits erect, green, with persistent calyx, style, and stigma; pedicel up to 16 mm long; seeds not seen.

Comments. *Pleradenophora* Esser belongs to the tribe Hippomaneae (Euphorbiaceae, Euphorbioideae) and was previously considered part of *Sapium* Jacq. and *Sebastiania* Spreng. *Pleradenophora* seeds have no aril, while *Sapium* seeds have an aril. *Pleradenophora* is distinguished from *Sebastiania* by the frequently glandular petioles (vs. generally non-glandular leaves), flowers with a clearly fused calyx (at least in the staminate flowers) (vs. sepals of the staminate flowers that are free or slightly fused), fruits with thicker (vs. thinner) walls, mericarp septa with (vs. without) a triangular division at the base, and only one vascular bundle (vs. generally three vascular bundles) per septum (Esser 2001, 2012; Melo et al. 2013). *Pleradenophora membranifolia* differs from its congeners by the presence of oval leaf lamina, with a pair (or rarely more) of glands on the subcordate to slightly auriculate base (Figure 1D, I). There is almost no difference in the morphology of *Pleradenophora membranifolia* collections from Panama and South America, except specimens from Panama usually have unisexual inflorescences of pistillate flowers, which was also observed in the field. Collections of this species from South America usually have bisexual inflorescences.

Distribution and habitat. *Pleradenophora membranifolia* occurs in various localities in South America; in Brazil, its southern and northern limits are the states of Paraná and Maranhão, respectively, and it has also been recorded in Peru and Bolivia (Figure 2). According to information from the available collections, this species occurs in the Cerrado, drylands (except in the Caatinga), including transition areas, remnants

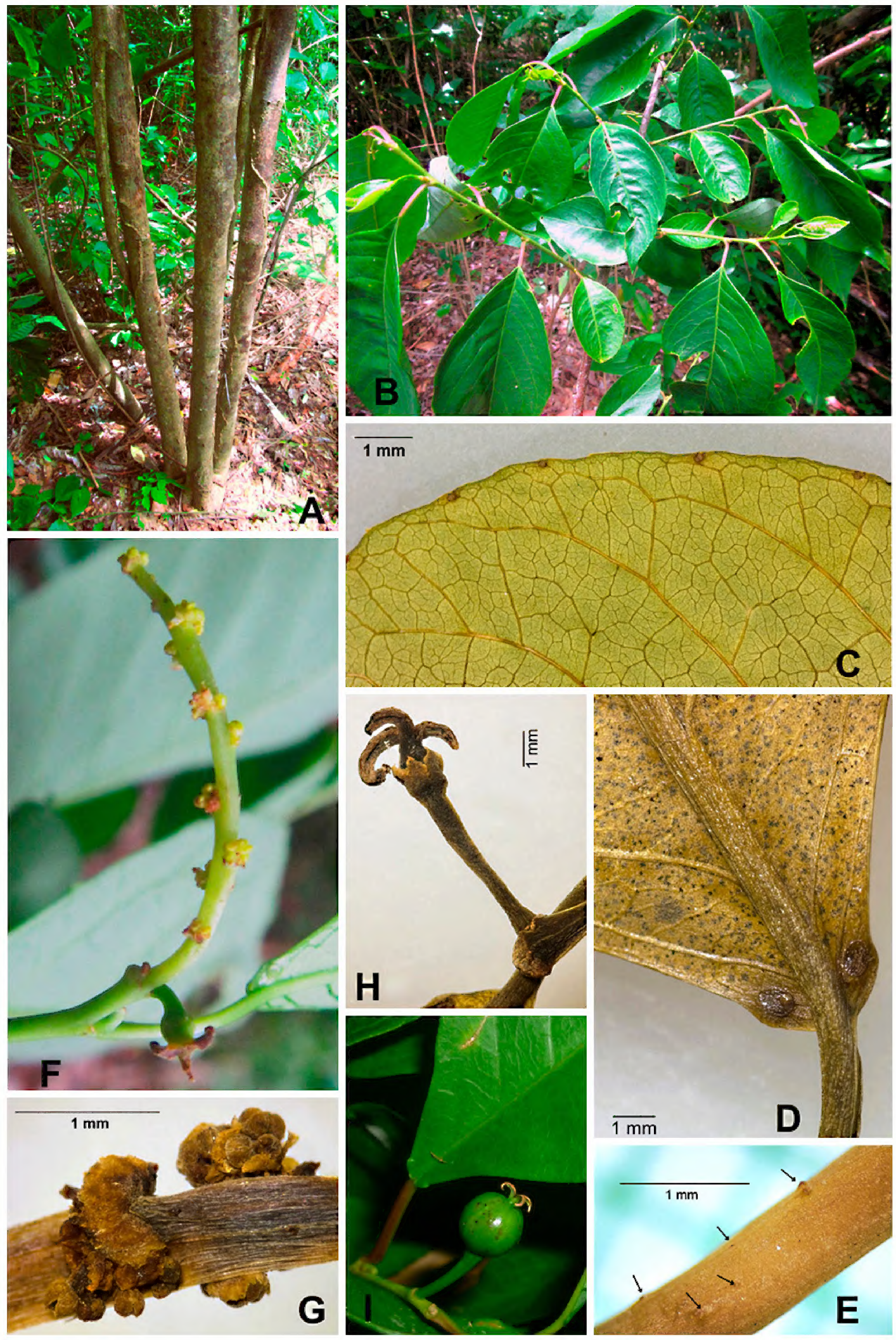

Figure 1. General morphology of *Pleradenophora membranifolia* **A.** Trunk branching at a low height. **B.** Fertile branches, note reddish petioles. **C.** Detail of a leaf lamina, note the glands on the margin. **D.** Detail of a lamina base, note the black spots on the surface and basilaminar glands. **E.** Petiole, the arrows indicate some glandular protuberances. **F.** Bisexual inflorescence. **G.** Staminate cymules. **H.** Pistillate flower. **I.** Immature fruit and lamina base, note the base is slightly auriculate.

of savanna formations and seasonally dry forests in the Amazon and Atlantic Forest domains. Studies also sampled *P. membranifolia* in riparian/gallery forests and transition zones with seasonally inundated fields, cerrado, cerradão, and seasonally tropical dry forest and disturbed vegetation types. Regarding edaphic factors, *P. membranifolia* occurs in calcareous soils and less often in clayey and sandy soils and on rocky outcrops.

In this work, we report this species for the first time in Central America; it is only known from one locality in seasonally dry forest in Garachiné (Figure 3), in Darién, at the eastern end of the Republic of Panama. It grows in calcareous soils near rocky outcrops. Despite making extensive floristic inventories in this locality, we only found 22 individuals of the species in an area of ca. 100 m^2.

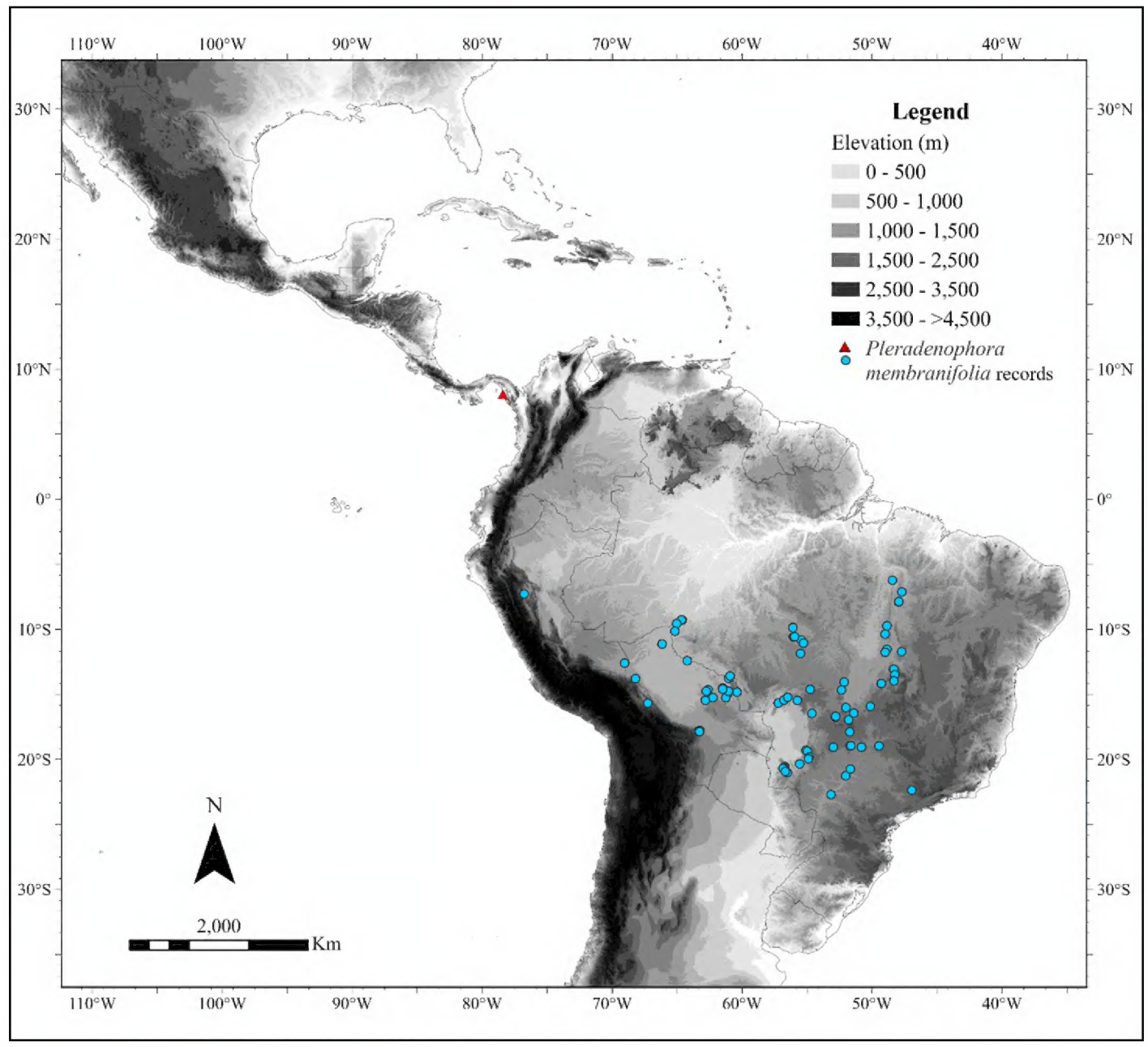

Figure 2. Herbarium records of *Pleradenophora membranifolia.* Triangle = new record from Panama; circle = previous records.

Figure 3. Habitat of *Pleradenophora membranifolia* in seasonal dry tropical forest in Punta Garachiné, Darién, Panama.

DISCUSSION

Studies indicated that *Pleradenophora* was had a disjunct distribution, from the southern United States to northern Central American and in the central region of South America (Bolivia, Brazil, and Peru) (Esser 2001, 2012). However, our new record of *P. membranifolia* in Panama (southern Central America) demonstrates that the genus does not have such a remarkably disjunct distribution.

On the other hand, the population of *P. membranifolia* in Panama is approximately 1,700 km from the closest population in South America, which is in Juanjuí, in the province of San Martín, Peru. The population in Panama occurs less than 1 km from the Pacific Ocean, making this species population the closest to the coast. Disjunct patterns in species of Euphorbiaceae are not rare, such as in *Gymnanthes boticario* Esser, M.F.Lucena & M.Alves, and *Croton laceratoglandulosus* Caruzo & Cordeiro, which occur in both the Caatinga in northeastern Brazil and SDTFs in Bolivia (Wurdack 2023). However, we cannot rule out that this

distribution is the consequence of a collection artifact since the herbarium collections of Euphorbiaceae in Ecuador and Colombia need to be better studied.

More accurate studies are needed to sample populations of *P. membranifolia* in Panama and South America. Also, integrating phylogenetics, ecology, and taxonomy could help answer questions related to biogeography, demographic changes, genetic divergence, and even speciation processes of this taxon.

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ADDITIONAL INFORMATION

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

No ethical statement is reported.

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Author contributions

Conceptualization: JFC. Data curation: JFC. Formal analysis: JFC, ML. Funding acquisition: JFC. Investigation: JFC. Methodology: JFC, ML. Supervision: JFC. Project administration: JFC, MSS. Writing – original draft: JFC. Writing – review and editing: JFC, MSS, ML.

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Data availability

All data that support the findings of this study are available in the main text.

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